MWMF Letter
Mixed Waste Management Facility
Lawrence Livermore National Laboratory

July 1995

Panel opens dialogue on mixed waste facility

Proposed Lab facility would allow treatments to be tested, evaluated

(Reprinted from an article by Don Johnston in the June 23 issue of Newsline, the LLNL newspaper)

The Mixed Waste Management Facility (MWMF) National Review Panel met for the first time Tuesday, June 20, at Lawrence Livermore National Laboratory (LLNL) to initiate a public dialogue on the demonstration of mixed waste treatment technologies.

Representatives from the Lab project, the Department of Energy, state of California, Alameda County, city of Livermore, and Tri-Valley CAREs were welcomed by Jay Davis, acting associate director for Environmental Programs. Discussions focused on the project's purpose, scope and regulatory requirements.

The project would serve as a "national testbed" to demonstrate safe, effective, and environmentally acceptable technologies for treating the growing inventory of low-level organic mixed waste generated by Department of Energy facilities. Mixed waste contains both hazardous and low-level radioactive components.

These new technologies would offer alternatives to the use of incineration. Currently in the design phase, the facility is scheduled to begin operation in 1998.

"We're developing a facility that will be used into the next century to evaluate new technology," MWMF Project Manager Ron Streit told panelists in his overview." The project is to demonstrate technology, not to do treatment.

"lt's unique in that it will be the only fully integrated pilot-scale demonstration facility in the country," he said. "The facility will address all aspects from preparation of waste for treatment to preparation of final waste forms after treatment."

The Lab is working closely with private industry in developing the technology with a view to eventually transferring the technology for commercial use. "A key goal of the project is to involve industrial partners in all phases of the project, and if the technologies are successful, we'd like to use them at LLNL," said Martyn Adamson, leader of waste treatment technologies development at LLNL.

Another issue sparked during the discussion was over the choice of molten salt oxidation (MSO) as the first technology to be demonstrated in the MWMF. MSO uses a flameless reaction to oxidize—destroy—the organic constituents of mixed and hazardous waste. In the process, the salt bath virtually eliminates toxic byproducts, like dioxins, which may be found in incineration exhaust.

Adamson stressed that the intent of the project is to be able to do comparative testing of alternative technologies. "We don't believe any one technology can treat all wastes," he said. "We're developing a suite of technologies."

MSO was chosen over non-thermal technologies because it can be used to treat a wide variety of waste streams, according to Adamson, who added that a "white paper" was prepared for the Environmental Protection Agency (EPA) explaining why MSO is not incineration. (See MSO Technical Profile on p. 2.)

State of California permit requirements put the project in a "catch-22" dilemma, Streit said. Because the technology is still in its infancy, the data needed to obtain even a Research Development and Demonstration (RD&D) permit cannot be obtained without testing.

Project leaders and state regulators as well as most members of the panel agree that the facility should be built and tested using surrogate waste. The data will then be used to apply for the appropriate permit from the Department of Toxic Substance Control.

DOE and state panelists said that evaluating the project's economic viability is a part of the planning and design process. The economics of the MWMF is a condition of obtaining an RD&D permit, said Terry Escarda of the California Department of Toxic Substance Control. "That's something we're taking a keen interest in."

Cathy Owens, a member of DOE' s mixed waste Focus Area Implementation Team, said "every technology we demonstrate has to show a market."

She said the project is striving to adhere to a strict DOE timetable while absorbing budget cuts and addressing public concerns about environmental risks. DOE wants demonstration technologies in place by the end of 1997.

The next meeting of the MWMF National Review Panel is expected to take place later this summer when the project's Environmental Assessment will be available for their review.

Streit noted that the meeting allowed many of the major stakeholders to raise and discuss their concerns about the testing of new mixed waste treatment technologies. "We got a lot on the table that will help this project move forward," he said. "This input is vital to deploying acceptable waste treatment systems for our nation's mixed waste problem."

Welcome to the first issue of the MWMF Newsletter. If you have any questions or want to get on our mailing list, please call Bert Heffner at (510) 424-4026.

Molten Salt Oxidation Technical Profile

This technology profile is intended for anyone interested in the disposal of hazardous and low-level mixed wastes (LLMW) that are in the form of organic liquids or sludges. This technology is also expected to work well on organic solids with a maximum dimension on the order of 6 mm (for injection purposes). Candidate DOE mixed waste streams for molten salt oxidation (MSO) treatment include: spent solvents, oils, and other organic liquids; crucible graphite; plutonium-contaminated leaded gloves; ion-exchange resins; and energetic materials (explosives, propellants, and pyrotechnics). This technology will also be of interest to those responsible for the disposal of chemical warfare agents and medical wastes.

What is Molten Salt Oxidation?

MSO is a thermal means of completely oxidizing (destroying) the organic constituents of mixed and hazardous waste. The flameless reaction takes place at 700 to 950°C in a pool of benign salts, usually either sodium carbonate or a eutectic of alkaline carbonates. Oxidant air and the waste stream are added together into the salt bath. Because the reaction takes place within the salt bath, the fugitive inventories found in incineration are virtually eliminated. The organic components of the waste react with oxygen to produce CO2, N2, and water. Halogens and heteroatoms such as sulfur are converted to acid gases, which are then "scrubbed" and trapped in the salt in forms such as NaCl and Na2SO4. Other incombustible inorganic constituents, heavy metals and radionuclides are held captive in the salt, either as metals or oxides, and are easily separated for disposal.

How Mature is this Technology?

Molten salt technology is not new. Rockwell International used the process approximately 20 years ago for coal gasification. During that period, they also demonstrated the effectiveness of molten salt for destroying hazardous organics such as PCBs and TCEs. Recently, molten salt has been demonstrated as an effective method for the destruction of mixed waste oils and energetic materials. The technology is mature enough to be put into a pilot-scale unit in the next few years.

Are there any insurmountable obstacles?

There appear to be no obstacles to the scale-up and use of MSO as an alternative to incineration for the waste streams described in the first section. In many respects this process has advantages over incineration. The large thermal mass of the molten salt provides a stable heat-transfer medium that resists thermal surges and ensures temperature uniformity and is therefore able to tolerate rapid process fluctuations. Flameouts are completely avoided, since MSO is a non-flame process that proceeds by catalytic liquid-phase oxidation reactions. MSO generates less off-gas than incineration, since it does not require supplemental fuel to sustain a flame. Operation of the MSO system is at temperatures hundreds of degrees lower than flame combustion temperatures, which, among other things, minimizes emissions of the radioactive materials from mixed wastes. The "scrubbing" of acid gases by the alkaline salts eliminates the need for a wet off-gas scrubbing system. Also, permitting the MSO process should be easier since it is not an incinerator.

What are the Operational Characteristics?

The pilot-scale unit currently being designed for implementation in the MWMF will have the following throughputs: 20 kg/hr for chlorinated organic liquids (DOE Waste Code 2210); 10 kg/hr for combustible solids (DOE Waste Code 5440); 6 kg/hr of non-halogenated organic liquids (DOE Waste Code 2220); 6 kg/hr for scintillation cocktails (DOE Waste Code 6140); and 5 kg/hr of Trimsol oil (DOE Waste Code 2120).

Can the Molten Salt Process be Integrated into a Complete Waste Processing System?

The MSO process is compatible with extensive use of standard industrial equipment, although the reactor vessel and feed injection system are uniquely designed and not off-the-shelf items.

What is the Facility Status for Implementation of the Molten Salt Process?

Over twenty technologies were evaluated for potential demonstration as the primary treatment processes in the MWMF, and MSO was chosen as the true incineration-alternative technology. The MWMF is scheduled to demonstrate MSO in FY98.

What are the Advantages of MSO over Incineration?

MSO has several advantages over incineration. First, since MSO units operate at much lower temperatures, generation of NOx is greatly reduced, as is the volatilization of heavy metals and radionuclides. Second, the generation of acid gas is eliminated because the acid gases (such as HCl and SO2) are scrubbed by the alkaline carbonates, producing instead water (steam) and the corresponding salt. Third, the formation of secondary toxins (dioxins, furans, and other products of incomplete combustion) are less likely with MSO. In an incinerator, hot spots and feed inhomogeneities limit the process controllability. MSO provides a stable heat-transfer medium with sufficient thermal mass/inertia to resist thermal surges, ensuring temperature uniformity, and provides increased and uniform contact time/residence time of the primary reactants, ensuring completeness of reaction. Finally, MSO generates less off-gas because there is no fuel required to sustain or initiate a flame in this process. The off-gases

from MSO are sent through standard dry off-gas clean-up equipment (bag filters or HEPA filters) to remove any remaining salt particles before undergoing gas analysis and release to the atmosphere.

What are the Requirements for Commercial Use?

The key requirement for commercialization of MSO as a waste treatment technology is the acceptance of MSO as the BDAT (Best Demonstrated Available Technology) or equivalent for the treatment of mixed waste. Technically, the resolution of economical salt recycling and the establishment of operation cost parameters are all that stand before its potential commercialization. The MSO process will be permitted and demonstrated through the MWMF, which should resolve these issues.

What Independent Reviews of the Technology Have Been Conducted?

Two independent reviews of MSO have been conducted. In November 1991, the DOE Grand Junction Projects Office conducted and facilitated a peer review process through its prime contractor, Chem-Nuclear Geotech, Inc. This provided a baseline evaluation of the MSO technology and established its present and potential readiness to treat DOE wastes. The second review was held in December 1993 by a panel of eight independent technical and program management experts. They conducted a technical review of the technology's attributes and determined that the technology was sufficiently promising as an alternative to incineration to be advanced to a pilot-plant stage.

Business Booms

Hundreds of suppliers are necessary to help as the MWMF moves toward reality. Over a dozen vendors, from Oakland to Burbank, Massachusetts to Colorado, are being evaluated as possible suppliers to the MSO salt recycle system. Other vendors from throughout California, mostly the Bay Area, and even from Connecticut and New York have already supplied needed hardware, supplies, and services to the Facility. And the brand names are top drawer. For example, control system suppliers include Allen-Bradley, Dell Electronics, Oracle, and QNX.

Over 65 potential suppliers, partners, and team members have responded to publicity and advertising in industry and business publications or through outreach at trade shows. At least one creative research and development agreement is in the works, and we are exploring other forms of working together with about a dozen firms. It seems some businesses think developing alternatives to incineration for mixed waste could make dollars and sense.

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Fact Sheet
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Mixed waste, the mixture of both radioactive and hazerdous waste, is a growing national problem. The U. S. produces an estimated 30,000 cubic meters annually and already has about 300,000 cubic meters in storage. Many medical procedures and technologies generate mixed waste, as did nuclear weapons production. Because there are few publicly acceptable treatment methods, most of this mixed waste must remain at its site of production. Other nations face the same problem.

Mission

The Mixed Waste Management Facility (MWMF) Project will demonstrate safe, effective, and environmentally acceptable processes for treating low-level organic mixed waste. The project is a national test bed that will establish viable, benign alternatives to incineration. The MWMF will be an integrated, pilot-scale demonstration facility that leads bench-scale technologies to commercial-scale operation.

The MWMF Project will reduce risks associated with the deployment of immature technologies by addressing engineering scale-up issues, integrating processes into a pilot-plant setting, and addressing permitting and stakeholder issues.

The MWMF will begin operations with the first treatment demonstration systems in 1998. The project will continue to operate well into the next century, evaluating safer, faster, and more cost-effective treatment technologies.

Scope

The project has two specific technical objectives: (1) to demonstrate safe, environmentally acceptable destruction of the organic components of typical DOE mixed wastes and (2) to demonstrate full integration of material management, waste preparation, emission control systems, water treatment, and preparation of solid waste forms meeting waste disposal requirements.

Molten Salt Oxidation (MSO), the first primary process technology selected, should be able to treat virtually all wastes that could be treated by incineration. In MSO, the organic portion of the waste is destroyed by catalytic oxidation in a fluid carbonate salt bath (700–950°C), which converts the organic material to carbon dioxide and water.

Inorganic residues, including the radioactive materials, are trapped in the molten salt. They are removed from the salt for processing into a final, nonleachable waste form, which is currently expected to be a ceramic. Excess halogen salts, such as sodium chloride, are also removed and processed for disposal; polymer encapsulation is currently expected to be used. The MWMF MSO system is designed to destroy wastes at rates of up to 20 kg/hr.

Because MSO is a catalytic, liquid-phase oxidation process, it does not exhibit the disadvantages of incineration. Incineration destroys waste using controlled-flame combustion. MSO, however, destroys the waste in a liquid salt bath. The bath chemistry captures chlorine, preventing the formation of secondary toxins such as dioxin. The lower, stable bath temperature also essentially precludes other noxious emissions commonly associated with incineration.

Another key aspect of the integrated demonstration is the safe and efficient preparation of the waste for treatment. The MWMF will demonstrate telerobots—robots with remote operators—to handle and sort mixed waste faster, more safely, and more cheaply than has been possible either manually or using older technologies. This will also reduce the generation of waste typically associated with manned operations, such as lab coats, booties, and gloves.

Assurances

The MWMF Project has three primary Environment, Safety, and Health (ES&H) assurance goals:

- Obtain approvals necessary to construct and operate the MWMF safely and in compliance with California regulations.
- Provide the EPA with satisfactory documentation to support permitting of an alternative treatment technology as allowed under Federal regulations.
- Establish a roadmap for completing ES&H documentation to deploy demonstrated technologies at LLNL or elsewhere.

Participation

The goal of the project's public participation process is to assure that MWMF activities are conducted in a manner acceptable to the public, that the process demonstrations meet scientific, economic, and public acceptance, and that there is a smooth transition from successfully demonstrated technologies to treatment. A National Review Panel, including representation from regulatory and government offices and from national environmental groups, is integral to the MWMF Project.

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For more information, contact Bert Heffner, MWMF Public Participation,
Lawrence Livermore National Laboratory, L-790, Livermore, CA 94550, (510) 424-4026